



"RED BOOKS" of the

BRITISH FIRE PREVENTION COMMITTEE.—No. 196.

Edited by the Executive.

Fire Tests with Glass

FIVE SKYLIGHT OPENINGS

FILLED IN WITH

"WIRED" GLASS

BY

MESSRS PILKINGTON BROTHERS, LIMITED

ST HELENS

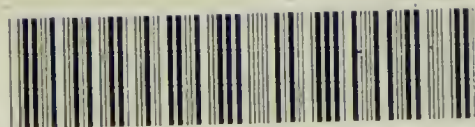
The Committee's Report

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LONDON, 1914.

PUBLISHED AT THE OFFICES OF
THE BRITISH FIRE PREVENTION COMMITTEE
(Founded 1837—Incorporated 1899)
8 WATERLOO PLACE, PAUL MALL

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BRITISH FIRE PREVENTION COMMITTEE.—No. 106.
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8 WATERLOO PLACE, PALL MALL.

Two Shillings and Sixpence

OBJECTS OF THE COMMITTEE.

The main objects of the Committee are:

To direct attention to the urgent need for increased protection of life and property from fire by the adoption of preventive measures.

To use its influence in every direction towards minimizing the possibilities and dangers of fire.

To bring together those scientifically interested in the subject of Fire Prevention.

To arrange periodical meetings for the discussion of practical questions bearing on the same.

To establish a reading-room, library and collections for purposes of research, and for supplying recent and authentic information on the subject of Fire Prevention.

To publish from time to time papers specially prepared for the Committee, together with records, extracts, and translations.

To undertake such independent investigations and tests of materials, methods, and appliances as may be considered advisable.

The Committee's Reports on Tests with Materials, Methods of Construction, or Appliances are intended solely to state bare facts and occurrences, with tables, diagrams, or illustrations, and they are on no account to be read as expressions of opinion, criticisms, or comparisons.

The Committee is not responsible for the views of individual authors as expressed in Papers or Notes, but only for such observations as are formally issued on behalf of the Executive.

Similarly the Committee is not responsible for any translation or any summarised translation or explanation of its Reports in a foreign language, even if issued in conjunction with the official English version.

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COCKS, BIDDULPH & CO., Charing Cross, S.W.

Testing Station:

NORTH BANK LODGE, HANOVER GATE, REGENT'S PARK, N.W.

Offices:

8 WATERLOO PLACE, Pall Mall, LONDON, S.W.

No. 5.

No. 4.

No. 3.

No. 2.

No. 1.



Fig. 13. VIEW OF UNDERSIDE OF SKYLIGHTS AFTER FIRE AND WATER TEST.

NOTE

In various "Notes" to earlier Reports attention has been called to the value of fire-resisting glazing as a useful ally in fire protection against exposure risk.

In the Report here presented the exposure risk met with in skylights is dealt with, inasmuch as five horizontal skylights, each measuring 2 feet by 2 feet ($0\cdot61m.$ by $0\cdot61m.$), were under investigation, and the result of the test indicated that glazing material is available for horizontal openings that can serve most efficiently to stop the spread of a fire of considerable severity.

The material with which these skylights were glazed was "wired glass," made in Great Britain, and the test to which this material was subjected was that necessary for obtaining classification affording "Temporary Protection" (Class B) under the Committee's Standards of fire resistance—i.e., the glazing had to withstand a fire test of one hour's duration at temperatures reaching 1500° Fahr. ($815\cdot5^{\circ}$ C.), followed by the application of water from a steam fire engine.

The Report shows that the classification desired under the Committee's Standards was obtained, the maximum temperature reached being 1600° Fahr. ($871\cdot1^{\circ}$ C.).

ELLIS MARSLAND.

*The Offices of the
British Fire Prevention Committee,
8 Waterloo Place,
London, S.W.*

October, 1914.

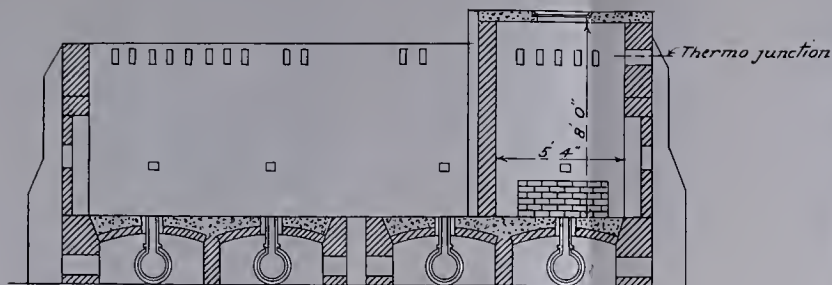
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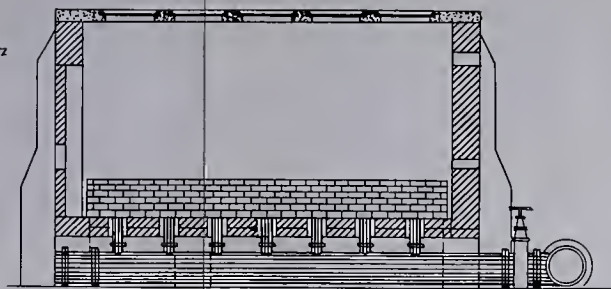
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Fig. 14. VIEW OF SKYLIGHTS NOS. 5 AND 4 FROM BELOW, AFTER FIRE AND WATER TEST
(No. 5 skylight was nearest to the opening from which water was applied)

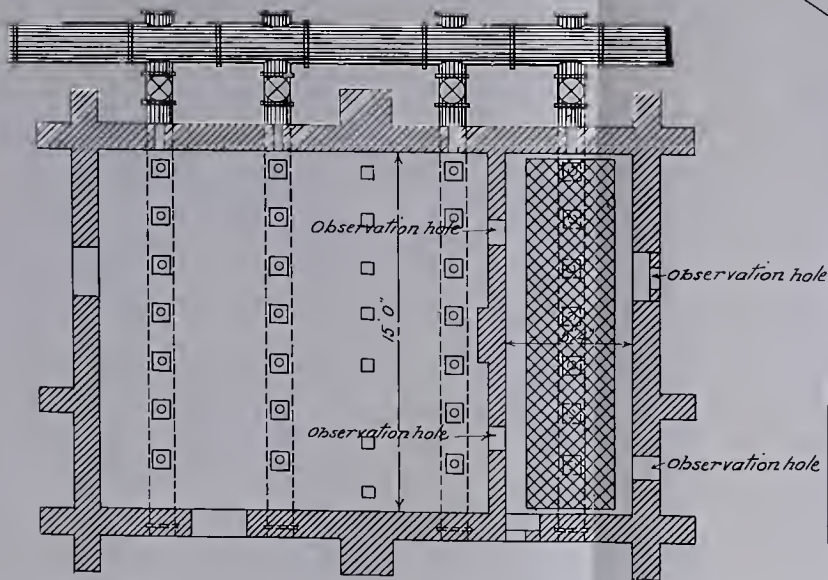


LONGITUDINAL SECTION

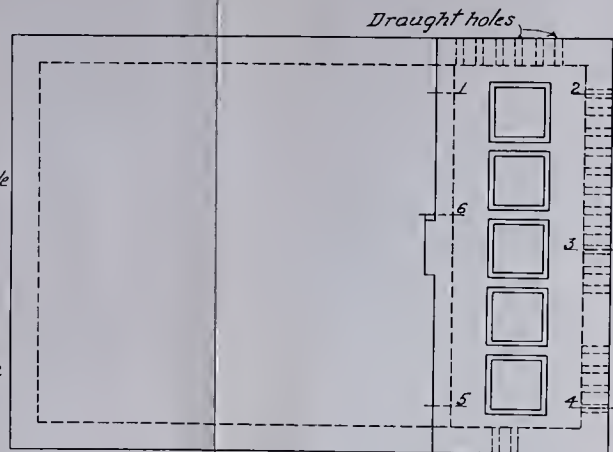


TRANSVERSE SECTION

NOTE Points marked 1 2 3 4 5 6 are thermo junctions attached to wires leading to pyrometers
No 6 is self recording



PLAN OF HUT



PLAN OF ROOF

No. 5. No. 4. No. 3. No. 2. No. 1.



Fig. 5. VIEW OF SKYLIGHTS, FROM ABOVE, BEFORE TEST.



Fig. 6. VIEW OF SKYLIGHTS, FROM ABOVE, AFTER FIRE AND WATER TEST.
(No. 5 skylight was nearest to the opening from which water was applied.)

No. 1. No. 2. No. 3. No. 4. No. 5.



Fig. 7. VIEW OF SKYLIGHTS, FROM BELOW, BEFORE TEST.



Fig. 8. VIEW OF SKYLIGHTS, FROM BELOW, AFTER FIRE AND WATER TEST.
(No. 3 skylight was nearest to the opening from which water was applied)

OFFICIAL REPORTS
OF THE
British Fire Prevention Committee

[FOUNDED 1897—INCORPORATED 1899]

FIRE TEST No. 196, JULY 22, 1914

Five Skylight Openings filled in with
WIRED GLASS

BY

MESSRS PILKINGTON BROTHERS, LIMITED
ST HELENS

OBJECT OF TEST.

To record the effect of a fire of 60 minutes' duration, the temperature to reach $1,500^{\circ}$ Fahr. (815.5° C.) but not to exceed $1,650^{\circ}$ Fahr. (898.8° C.), followed by the application of water for two minutes on the fire side with the view of being classified as affording "Temporary Protection" (Class B).

Note.—The openings were numbered Nos. 1, 2, 3, 4, and 5 and were each filled in with a sheet of "wired rolled" glass $\frac{1}{4}$ in. (0.006m.) thick fixed in a concrete rebate and bedded around the edges with cement stopping.

Note.—The sight size of each skylight opening was the standard size 2ft. by 2ft. (0.61m. by 0.61m.).

SUMMARY OF TEST.

Immediately on lighting the gas the glazing in each skylight commenced to crack in various directions.

SKYLIGHT No. 1.

In three minutes the surface of the glass on the fire side began flaking and continued to do so at intervals up to 38 minutes.

Fire did not pass through the glazing.

The glazing remained in position after the application of water. It was cracked and sintered all over. Water did not pass through the glazing.

SKYLIGHT No. 2.

In one minute the surface of the glass on the fire side began flaking and continued to do so at intervals up to 45 minutes.

Fire did not pass through the glazing.

The glazing remained in position after the application of water. It was cracked and sintered all over.

The glazing was perforated on the eastern edge and some water came through.

SKYLIGHT No. 3.

In 30 minutes the surface of the glass on the fire side began to flake.

Fire did not pass through the glazing.

The glazing remained in position after the application of water. It was cracked and sintered all over.

Water did not pass through the glazing.

SKYLIGHT No. 4.

Some slight flaking of the surface of the glass on the fire side was observed after the Test.

Fire did not pass through the glazing.

The glazing remained in position after the application of water. It was cracked and sintered all over and there were 10 small perforations, which allowed some water to pass through.

SKYLIGHT No. 5.

In 40 minutes the surface of the glass on the fire side began to flake.

Fire did not pass through the glazing.

The glazing remained in position after the application of water. It was cracked and sintered all over.

The glazing was perforated and water came through.

Note.—Water was applied at the end of the Hut nearest No. 5.

Classification "Temporary Protection" (Class B) was obtained.

DESCRIPTION OF THE TESTING PLANT.

(See Figs. 1 to 4.)

The testing chamber was located at the Committee's Testing Station, and being the southern portion of Hut No. 3, a compartment of which was divided from the rest of the hut by a 9in. (0.229m.) wall.

The compartment was constructed as shown of stock bricks in lime mortar and measured internally 5ft. 4in. by 15ft. (1.625m. by 4.572m.).

The roof of the compartment was 8ft. (2.438m.) above the floor, and was constructed of reinforced concrete 6in. (0.152m.) thick, in which were formed five rebated openings 2ft. by 2ft. (0.610m. by 0.610m.) to receive the glass.

There was a door opening on the south side 2ft. by 4ft. (0.610m. by 1.219m.) and one on the west side 1ft. 4in. by 6ft. (0.406m. by 1.829m.), which were bricked up with 4½in. (0.114m.) brickwork and an observation hole left in each protected by a sheet-iron cover.

There were two observation holes in the north wall, each protected by a sheet-iron cover.

There were ventilation holes in the east and south walls.

The fuel used was gas produced at the station, the supply being regulated by valves and dampers. The gas was admitted through a mixing chamber of fire bricks into the testing compartment as indicated on *Figs. 1 to 4*.

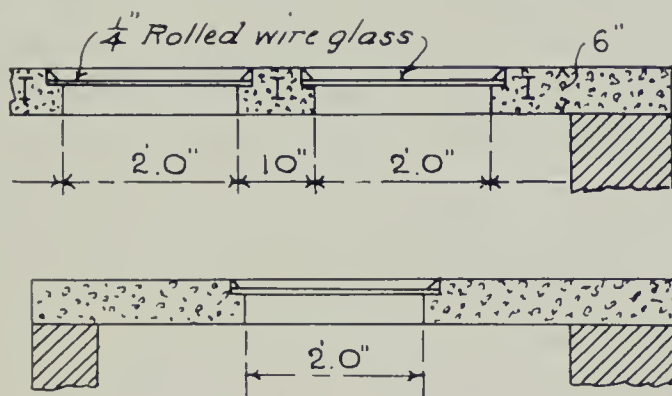
Pitkin-White pyrometers were used for recording temperatures, and records were taken at points Nos. 1, 2, 3, 4, 5, and 6 inside the compartment, No. 6 being self-recording.

The photographs were taken by daylight.

The stream of water was applied through a hose and branch with a $\frac{3}{4}$ in. (0.019m.) nozzle supplied by a small steam fire engine fitted with a pressure gauge.

DESCRIPTION OF OPENINGS AND GLAZING.

There were 5 openings, each 2ft. by 2ft. (0.61m. by 0.61m.), formed in the concrete roof of the compartment, with a 3in. by 2in. (0.076m. by 0.051m.) rebate round the top edge of each. Into



DETAIL SECTIONS

this rebate the wired glass was fixed, the size of each sheet being 2ft. 6in. by 2ft. 6in. (0.762m. by 0.762m.) and the sight size 2ft. by 2ft. (0.61m. by 0.61m.). A splayed cement fillet secured the glass in position. The glazing was "wired rolled" $\frac{1}{4}$ in. (0.006m.) thick.

LOG OF THE TEST.

On July 22nd, 1914, the Test was undertaken.

At 3 p.m. the meteorological observations at the Botanic Gardens, Regent's Park, read as follows:

State of weather, overclouded; Wind, N.; Barometer, 29.66in.; Attached Thermometer, 66° Fahr. (18.8° C.); Wet Bulb, 57.5° Fahr. (14.1° C.); Dry Bulb, 60° Fahr. (15.5° C.) Remarks: Dull day, with slight rain and wind.

The following is the log of the test:

No. 5. No. 4. No. 3. No. 2. No. 1.



Fig. 9. VIEW OF SKYLIGHTS DURING TEST (AT 17 MINUTES)

No. 1.

No. 2.

No. 3.

No. 4.

No. 5.

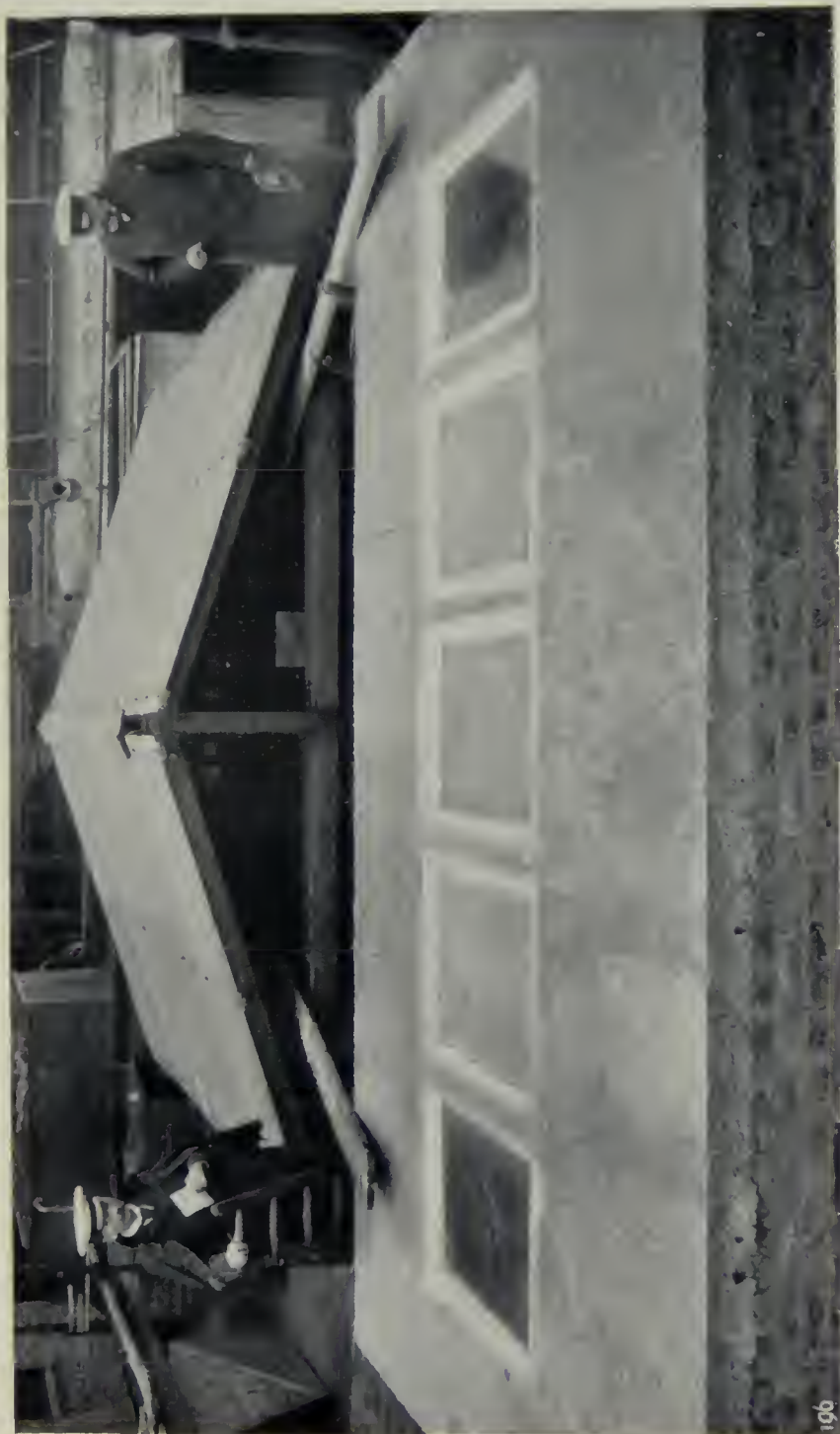


Fig. 10. VIEW OF SKYLIGHTS DURING TEST (AT 30 MINUTES).

No. 5.

No. 4.

No. 3.

No. 2.

No. 1.



Fig. 11. VIEW OF SKYLIGHTS DURING TEST (AT 15 MINUTES).

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No. 5

No. 4

No. 3

No. 2

No. 1



196

Fig. 12. VIEW OF SKYLIGHTS DURING TEST (AT 60 MINUTES).

OBSERVATIONS ON INSIDE DURING TEST

Time, p.m.	No. 1 Skylight.	No. 2 Skylight.	No. 3 Skylight.	No. 4 Skylight.	No. 5 Skylight.	Mat. cracks
2.0	Gas lighted.	Gas lighted.	Gas lighted.	Gas lighted.	Gas lighted.	0
2.1	Glass crack- ing all over.	Glass crack- ing all over. Two pieces of glass about 4 in. by 2 in. (0-102m. by 0-051m.) flaked off underside.	Glass crack- ing all over.	Glass crack- ing all over.	Glass crack- ing all over.	1
2.3	A piece of glass about 9 in. by 2 in. (0-229m. by 0-051m.) flaked off underside.					3
2.7		Further flake about 2 in. by rin. (0-051m. by 0-025m.).				7
2.10		Further small flake.				10
2.25	Further small flake.					25
2.28	Further flake about 2 in. by 2 in. (0-051m. by 0-051m.) at corner.					28
2.30		Further flake about 6 in. by rin. (0-152m. by 0-025m.).				30
2.33	Further small flake.					33
2.38	Further three small flakes about rin. by rin. (0-025m. by 0-025m.).					38
2.39			Flake about 4 in. by rin. (0-102m. by 0-025m.) and one about rin. by rin. (0-025m. by 0-025m.).			39
2.40					Flaking commenced.	40
2.45		Further flake at cor- ner about 3 in. by 2 in. (0-076m. by 0-051m.), also pieces bang- ing.				45

Time. P.M.	OBSERVATIONS ON OUTSIDE DURING TEST.	Mins. elaps'd
2.0	It rained slightly at commencement of Test and continued intermittently during Test.	0
2.1	Within one minute of the gas being lighted the glass in each of the Skylights Nos. 1, 2, 3, 4 and 5 commenced to crack.	1
2.6	A little flaking occurred on Skylight No. 2.	6
2.10	Surface of glass very hot. Slight cracks showing in the cement filleting surrounding Skylights Nos. 1, 2 and 3.	10
2.14	A crack appeared in the concrete roof in which the skylights were fixed on the north side from Skylight No. 2 to the outer edge.	14
2.15	Raining heavily. The water did not dry on the glass very quickly and the cement filleting remained wet.	15
2.25	Rain had practically ceased. A little flaking occurred on Skylight No. 1.	25
2.27	The crack in roof mentioned at 2.14 had developed and smoke came through and occasional reports were heard.	27
2.30	The above-mentioned crack in roof opening further causing crack in glass in line with it and also causing it to open slightly.	30
2.32	Skylights Nos. 1 and 2 getting luminous.	32
2.33	Further flaking taking place on outside of Skylight No. 1. Crack in roof observed at 2.14 becoming discoloured by smoke.	33
2.35	A crack appeared in roof from centre of Skylight No. 1 on the south side extending outwards.	35
2.37	The crack in roof mentioned at 2.35 widening and smoke coming through. This crack caused a crack in Skylight No. 1.	37
2.40	The crack in roof mentioned at 2.35 opening and slightly opening the crack in Skylight No. 1. A little further cracking in Nos. 5 and 4. A crack appeared in concrete roof on the north and south sides of Skylight No. 4.	40
2.43	Skylight No. 2 more luminous, the flames touching it.	43
2.45	The crack in roof mentioned at 2.40 developing.	45
2.48	Skylights Nos. 4 and 5 bulging upwards slightly and cement filleting on the north side about centre cracked through. Skylight No. 1 bulging upwards slightly. Skylight No. 2 slightly depressed. Skylight No. 3 slightly depressed, but less than No. 2. Sand was placed over the several cracks in roof.	48
2.51	Crack in roof from north-west corner of Skylight No. 1 extending towards north edge and slight smoke issuing.	51
3.0	Fire Test closed. Fire did not pass through the glass.	60

See Figs. 9, 10, 11 and 12.

Time. P.M.	OBSERVATIONS ON OUTSIDE DURING TEST.	Mr. Clay - 1
3.2	Water was applied through the west opening to the underside of the skylights for two minutes through a $\frac{3}{4}$ in. (0.019m.) jet. The effect of which was to crack and sinter the glass all over on the under side and loosen the glass in Skylights Nos. 3, 4 and 5. Skylight No. 2 was perforated along the eastern side and water came through. Skylight No. 4 was perforated in several places and water came through and the filleting on the east side was displaced. Skylight No. 5 had a large perforation about 12in. by 8in. (0.305m. by 0.203m.), was bulged upwards, some of the glass was displaced, and small detached pieces of glass were adhering to the exposed wire reinforcement and the filleting on the east side was displaced.	62
3.4	The Test closed.	64

OBSERVATIONS AFTER TEST ON JULY 23, 1914.

See Figs. 13 and 14.

INSIDE.

Skylight No. 1.—The whole surface of the glass was cracked and sintered.

A portion of the surface of the glass had flaked off for an area of about 12in. by 2in. (0.305m. by 0.051m.) up to the wire reinforcement.

Skylight No. 2.—The whole surface of the glass was cracked and sintered.

A portion of the surface had flaked off in several places. The eastern edge was perforated, exposing the wire reinforcement, and the edge was lifted from the cement setting on this side where struck by the jet.

Skylight No. 3.—The whole surface of the glass was cracked and sintered.

A small portion of the surface was flaked off.

The eastern edge was lifted from the cement setting where struck by the jet.

Skylight No. 4.—The whole surface of the glass was cracked and sintered.

A small portion of the surface was flaked off.

The eastern edge was lifted from the cement setting where struck by the jet.

The glass had several small perforations.

Skylight No. 5.—The whole surface of the glass was cracked and sintered.

The surface was flaked in several places.

There was a large hole on the eastern side about 12in. by 8in. (0.305m. by 0.203m.) with small detached pieces of glass adhering to the exposed wire reinforcement.

The eastern side was lifted from the cement setting where struck by the jet.

OUTSIDE.

Skylight No. 1.—The glass was bulged upwards about $\frac{5}{16}$ in. (*0.008m.*). The cement filleting was slightly damaged. One small perforation on the east side about the centre.

Skylight No. 2.—There was an open crack down the centre of the glass extending about half way across.

The glass was depressed in the centre about $\frac{1}{4}$ in. (*0.013m.*).

There were perforations along the eastern edge and the cement filleting was slightly damaged.

Skylight No. 3.—There was a small perforation in centre $\frac{1}{2}$ in. (*0.127m.*) from eastern edge.

The glass was depressed in centre about $\frac{1}{8}$ in. (*0.003m.*)

The cement filleting was damaged on the eastern edge.

Skylight No. 4.—The glass was bulged upwards in centre about $1\frac{1}{4}$ in. (*0.032m.*).

There was an open crack in centre and ten small perforations over surface.

The cement filleting was displaced on the eastern edge and partly so on the northern for about 10 in. (*0.254m.*).

Skylight No. 5.—The glass was bulged upwards on the eastern side about $1\frac{1}{2}$ in. (*0.038m.*).

There was a large perforation in the crown of the bulge exposing the wire reinforcement to which was adhering small detached pieces of glass.

The cement filleting was displaced on the eastern side.

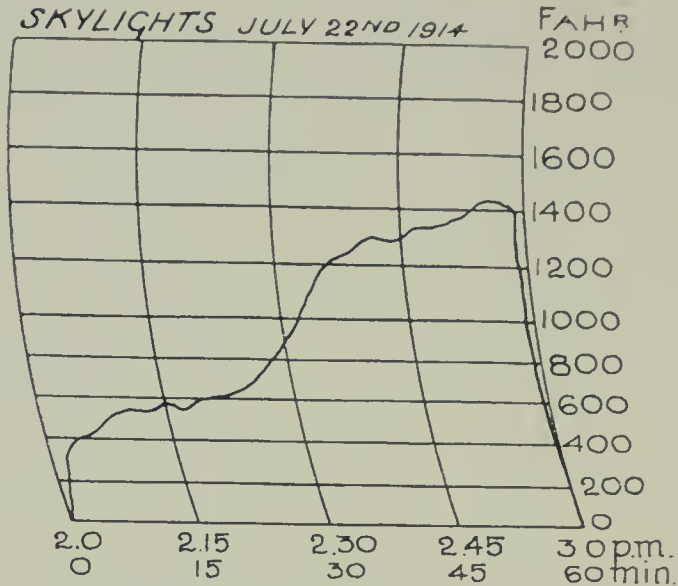
TEMPERATURES.

The temperatures read from observation records off pyrometer points Nos. 1, 2, 3, 4, and 5.

Time. P.M.	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	Mins. elap'd.
	Deg. Fahr.	Deg. Fahr.	Deg. Fahr.	Deg. Fahr.	Deg. Fahr.	
2.5	580	560	580	560	550	5
2.10	680	670	670	620	630	10
2.15	760	720	720	700	700	15
	(104.4)	(382.2)	(382.2)	(371.1)	(371.1)	
2.20	800	780	780	750	740	20
2.25	880	880	840	800	790	25
2.30	920	940	900	830	850	30
	(193.3)	(501.1)	(182.2)	(443.3)	(151.1)	
2.35	1120	1140	1100	980	1000	35
2.40	1300	1250	1240	1100	1200	40
2.45	1420	1380	1400	1250	1240	45
	(771.1)	(748.8)	(760.0)	(676.6)	(671.1)	
2.50	1490	1420	1440	1290	1280	50
2.55	1530	1450	1500	1300	1380	55
3.0	1600	1520	1500	1420	1380	60
	(871.1)	(826.6)	(845.5)	(771.1)	(748.8)	

The temperatures in italics are Centigrade.

The temperatures from the continuous record off pyrometer point No. 6 read as follows:



GENERAL ARRANGEMENTS.

The test was carried out according to the procedure laid down by the Executive for investigations of this description, and was conducted by a Sub-Committee comprising:

Ellis Marsland (District Surveyor) (*Gen. Honorary Secretary*),
Directing Member.

Percy Collins, J.P., F.S.S. *Deputy Directing Member.*

Bertram Chatterton, A.M.Inst.C.E. (Insurance Surveyor), *Deputy Directing Member.*

J. Herbert Dyer.

R. W. Henderson, J.P., M.D. (Hon. Chief Officer, Rickmansworth Fire Brigade).

H. G. Marshallsay (Chief Officer, Aldershot Fire Brigade).

A. E. Nichols, M.Inst.C.E. (Borough Surveyor, Folkestone).

Stanley W. Thorpe (Chief Officer, Kodak Fire Brigade).

A. H. Lister (Engineer to the Committee) assisted the Sub-Committee.

The Council was represented for the testing operations of July 22nd, 1914, by:

The Right Hon. The Earl of Londesborough, K.C.V.O.

The Executive was represented for the testing operations of July 22nd, 1914, by:

Edwin O. Sachs, F.R.S.Ed., *Chairman*.

Oswald C. Wylson, F.R.I.B.A.

The Committee's Hon. Medical Officer, Major R. J. Maitland-Coffin, F.R.C.P., was in attendance on July 22nd, 1914, assisted by a sergeant of the St John's Ambulance Association.

The police arrangements were under the direction of Mr. D. W. Wood (Insurance Surveyor) and the Committee Rooms were in charge of Mr. J. W. Brooker (late Chief Officer, Weybridge Fire Brigade).

The general body of members was represented for the testing operations of July 22nd, 1914, by:

Messrs. S. G. Gamble, F.S.I., A.M.Inst.C.E. (Divisional Officer, London Fire Brigade); G. Hayles (Surveyor, Commercial Union Co., Ltd.); Louis T. Healy, A.M.Inst.E.E. (Surveyor, Royal Insurance Co.); F. W. Lance (Surveyor, North British and Mercantile Insurance Co.); F. G. Sneath (Liverpool, London, and Globe Insurance Co.); B. Sworder (Surveyor, Liverpool, London and Globe Insurance Co.).

The following subscribers and visitors attended at the Testing Station by special invitation of the Executive during the testing operations of July 22nd, 1914:

Messrs. M. D. Barton (Inspection Section, London Fire Brigade); J. F. Bell (Chief Officer, Kingston, Surbiton and District Fire Brigade); G. Bellhouse (Superintending Inspector, Factory Department, Home Office); C. Buchanan (Committee on Bulkheads, Board of Trade); H. R. Champness, M.V.O. (Committee on Bulkheads, Board of Trade); — Churchward (Exhibitions Branch, Board of Trade); J. Clunes (London Assurance Corporation); Professor Dobbie, D.Sc., LL.D., F.R.S. (The Government Chemist); Herbert W. Ely (Secretary, Office of the Agent-General for Tasmania); W. Harvey (Engineer, Office of the Agent-General for Tasmania); A. H. Honeywill (Surveyor's Department, Commercial Union Assurance Co., Ltd.); T. C. Hunter (Superintending Civil Engineer, Admiralty); — Jamieson (Head of Fire Section, Messrs. Harrods, Ltd.); A. J. Marshall (Architects' Division, H.M. Office of Works); H. A. McFerran (Chief Engineer, H.M. Office of Works); F. S. Miles (The Fine Art and General Insurance Co.); Captain Mitchell, R.E. (Royal Arsenal, Woolwich); F. J. Plaice (London and North Western Railway Co.); W. Pott, A.R.I.B.A. (Principal Architect, H.M. Office of Works); Col. W. R. Stewart (Assistant Director of Fortifications and Works, War Office); J. Symon; G. Townsend (Building Act Section, London County Council); Alderman Henry Tozer (Westminster City Council).

Messrs. Pilkington Brothers, Ltd., were represented on July 22nd, 1914, by:

The Hon. E. H. Cozens-Hardy; Messrs. L. Lackland, R. H. Mather,
G. L. Pilkington, W. Smith.

Signed,

For the Sub-Committee conducting the Test:

ELLIS MARSLAND.

For the General Testing Arrangements Sub-Committee:

PERCY COLLINS.

BERTRAM CHATTERTON.

For the Executive:

EDWIN O. SACHS.

Published by the Committee as
directed by the Executive.

Verified a true copy of the
Report ordered to be published.

HORACE S. FOLKER.
(Hon. Treasurer).

SPENCER, GIBSON & SON
(Solicitors).

Date—October 14, 1914.

Date—November 4, 1914.

***Lists of the Committee's Publications, etc., are obtainable upon
written application to the Assistant Secretary, 8 Waterloo Place,
Pall Mall, London, S.W.***



